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GAMING: PROSPECTIVE FOR FORECASTING

Garry D. Brewer

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Santa Monica, California

February 1974

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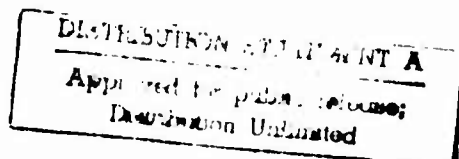
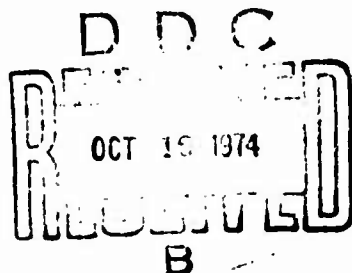
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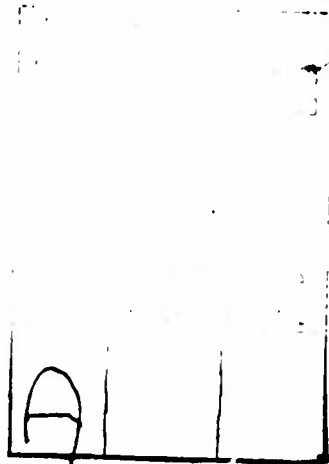
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ABSTRACT

Gaming, including many distinct types of techniques, has been used for thousands of years for many purposes, including the forecasting of man's affairs. Despite its venerability, the activity has many unrecognized and unrealized potentials--unrecognized because, among other reasons, several fundamental conceptual issues have not been well or thoroughly developed and unrealized because many fundamental questions remain unanswered. Concepts and questions are developed and raised, respectively, and several directions for research in the international relations setting are sketched out, including technical issues related to game size, supporting data, and methods of validation, and substantive issues related to terrorism, crisis decisionmaking, deception, and war's termination.

ACKNOWLEDGMENTS

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I. INTRODUCTION

The ever-present desire to anticipate and manage the future intelligently has so far been directly thwarted by the complexity of most social systems.¹ For instance, the by now classic method of extrapolating trends may be an effective forecasting technique only so long as a complex system is largely inert, the number of factors considered is relatively small, the interconnections between factors are few and basically understood, and no unexpected exogenous or structural changes occur. If these conditions do not hold, as they usually do not, forecasting by extrapolation may be impossible or may generate erroneous and misleading information.² A revised conception of projection and alternative methods then may be

*Prepared as Chapter 13 in Thomas Robinson and Nazli Choucri, eds., *Forecasting in International Relations* (San Francisco: W. H. Freeman, 1974 forthcoming). Much of the following discussion stems from a Defense Advanced Research Projects Agency (ARPA) sponsored "Gaming Evaluation Project" conducted by Martin Shubik and the author at The Rand Corporation during the period July 1970-June 1972. Special appreciation is due Austin Kibler for his continuing encouragement and trust.

¹Todd R. LaPorte, ed., *Organized Social Complexity: Challenge to Politics and Policy* (Princeton: Princeton University Press, 1974 forthcoming); Ronald D. Brunner and Garry D. Brewer, *Organized Complexity: Empirical Theories of Political Development* (New York: The Free Press, 1971); and Warren Weaver, "Science and Complexity," *American Scientist*, Vol. 36 (1948), pp. 536-544.

²Ronald D. Brunner and Garry D. Brewer, "Policy and the Study of the Future: Given Complexity, Trends or Process?" in Brewer and Brunner, eds., *Political Development and Change: A Policy Approach* (New York: The Free Press, 1974 forthcoming).

required. In which case, simulations, games, process models, scenarios, group judgment techniques, planning, utopia writing, and developmental constructs must be utilized.

Up to now, forecasting specialists have moreover limited themselves to a few of these techniques. Ideally, the techniques could be combined in the following fashion.

One technique is to extrapolate quantified trends and distributions to locate zones of probable contradiction or conflict, and to utilize available knowledge of the interdependencies among conditioning factors to make an estimate of the probable outcomes. The hypotheses thus developed can be evaluated in the light of nonquantified information provided by competent observers.³

The raw ingredients for useful forecasting are thus clear: quality data on important trends, some understanding of data relationships, a reasonably clear understanding and statement of individual and collective goals, and finally systematic methods and procedures by which a full and appropriate range of information may be brought to bear on what is indicated by the projected trends. It is the last, or methodological prerequisite on which we shall focus attention, particularly gaming.

The gaming art exists in an unsettled condition, one indication of which is that there are no generally acknowledged and used definitions to characterize it. In a recently completed survey of modeling, simulating, and gaming activities,⁴ the authors were forced to adopt the acronym "MSG" to designate "model, simulation, or game" so that particular

³Harold D. Lasswell, "The Future of the Comparative Method," *Comparative Politics*, Vol. 1 (October 1968), pp. 3-18, at p. 14.

⁴Martin Shubik and Garry D. Brewer, *Models, Simulations, and Games--A Survey* (Santa Monica: The Rand Corporation, R-1060-ARPA/RC, May 1972).

usages of these terms could be accommodated. Lack of agreement about the meanings of these three primitive terms is the norm, and there continue to be serious, unresolved definitional problems. Hopefully, the following terminological exercise establishes meanings which are sufficiently clear for the purposes of this exposition.⁵

- o *Gaming*: A gaming exercise employs human beings acting as themselves or playing simulated roles in an environment which is either actual or simulated. The players may be experimental subjects or participants in an exercise being run for teaching, operational, training, planning, or other purposes.

A major application of the basic technique is international relations gaming in which activities involving two or more interacting nation-actors are depicted using rules, data, and procedures designed to replicate the essential features of an actual or assumed real-life situation. Games can be accomplished manually, can be computer-assisted, or can be wholly computerized.

- o *Simulation*: Simulation involves the representation of a system or organism by another system or model, which is designed to have a relevant behavioral similarity with the original system. Games utilize a simulated environment or simulated roles for the players or both. In general, all games are simulations. However, not all simulations are usefully regarded as games.

Computer simulation is an analytical technique which involves the use of mathematical and logical models to represent the study and behavior of real-world or hypothetical events, processes, or systems over extended periods of time.

- o *Model*: Conducting a computer or computer-assisted game or related simulation requires the use of a computerized model. As used in this context, a model is a document or program containing all rules, methodology, techniques, procedures, and logic required to simulate or approximate reality. A computerized model is a computer program or series of programs, designed to simulate the logic of actions or interactions of an environment or context and provide the results to player personnel for subsequent analysis.

Contained in these definitions are two important ways in which the gaming field may be conceptualized: according to the *types* of games that exist or according to the *purposes* for which games are played.

⁵*Ibid*; pp. 80-82 (abstracted).

II. TYPES OF GAMES⁶

While many individuals label themselves "gamers," it is useful to distinguish four general types of games: analytic models, machine simulations, man-machine games, and free-form games. Examples of each type may be found in fields as far removed as educating pre-schoolers and calculating assured destruction in a nuclear exchange; however, these four typical categories are capable of encompassing most activities.⁷

Analytic models are usually quite abstract, poor in the number of variables explicitly considered, but rich in ease of manipulation and clarity of insight.⁸ For many questions, the analytic model may give a single number for an answer, as contrasted with multiple, interrelated indicators of system behavior that may result from the use of other techniques.

⁶The discussion of this section follows that contained in Martin Shubik and Garry D. Brewer, "Systems Simulation and Gaming as an Approach to Understanding Organizations," in Arthur I. Siegel, ed., *Symposium on Computer Simulation as Related to Manpower and Personnel Planning* (Washington: Bureau of Naval Personnel, July 1971, pp. 15-33).

⁷A more thorough review of the general gaming literature is contained in Martin Shubik, Garry D. Brewer, and Eve Savage, *The Literature of Gaming, Simulation, and Model-Building: Index and Critical Abstracts* (Santa Monica: The Rand Corporation, R-620-ARPA, June 1972). This document is organized around some thirteen separate, coded categories including game type, purpose, mathematical sophistication, game name, year published, and so forth.

⁸Thomas Schelling's work is one well-known example of this type; see his "The Strategy of Conflict: Prospectus for a Reorientation of Game Theory," *Journal of Conflict Resolution*. Vol. 2, No. 3 (September 1958), pp. 203-264, for one succinct statement of the basic ideas. For military applications, Melvin Dresher's *Games of Strategy: Theory and Applications* (Englewood Cliffs, New Jersey: Prentice-Hall, 1961) is a standard reference.

Game theory has had certain applicability in analytic modeling, although applications of the theory have resulted in highly variable degrees of success, an outcome frequently related more to the sophistication and ingenuity of the analyst than to simple technical virtuosity.⁹

An analytic model may help in sorting out basic problem elements in a real setting that, once recognized, usually can be resolved or at least better understood. Analytic models are usually too circumscribed to solve actual problems directly. However, because they are normally simply and clearly posed, they may shed light on potential difficulties, indicate where additional measurements are most needed, and identify and order critical omissions. Such is the case, for example, in the well-known, "Prisoner's Dilemma" game, where the barest essentials of a complex decision process are reduced to simple matrix form.

While analytic models have important uses, those using them often act as if there were no limitations: there are.

Methodology *per se* is less crucial in determining the worth of the product produced than the skill and judgment of the analyst who applies it. A highly simplistic and objectively inadequate model may produce valuable and insightful conclusions in the hands of a skilled and thoughtful analyst who is substantively knowledgeable in his subject. The same model may produce faulty, erroneous, or misleading conclusions in the hands of a less thoughtful analyst, even when its application is technically correct.¹⁰

In harsh contrast with analytic models, machine simulations frequently involve many variables; many seem to make a fetish of

⁹The relationship between gaming and game theory has been treated carefully in Martin Shubik, "On Gaming and Game Theory," *Management Science*, Vol. 18, No. 5 (January 1972), pp. 37-49.

¹⁰Private communication, Ralph Strauch (a statistician specialized in the analysis of strategic exchange calculations and processes), September 1973.

"realism."¹¹ Rationales for simulations by machine are many and varied. One common and frequently valid reason is that mathematics is a relatively impoverished language, whereas the computer allows one to capture the richness of a real system. Often left unsaid is the enormous price one is likely to pay to approximate that reality: as measured in the quantities of data needed and in the difficulty anyone has in understanding the logical processing of the large simulations.

Man-machine exercises usually involve a digital computer and people playing some of the roles in the modeled system. People may be used because they are cheaper than the software needed to reproduce some required behavior, or people may be used because human factors (particularly judgment) are important in the situation being analyzed. The Rand Corporation's Logistic Simulation Laboratory provided an example of a man-machine simulation in which people were used more as an integral part of the machinery than as subjects for human factor analysis.¹² John L. Kennedy's pioneering work, on the other hand, is an example of human factor analysis.¹³ UCLA's

¹¹TEMPER, a very large international relations machine simulation appears to have suffered particularly from this problem. For a short summary of the model, see Clark Abt, "War Gaming," *International Science and Technology* (August 1964), pp. 29-37. A thorough critique is contained in M. Balinski et al., *Review of the TEMPER Model--Final Report* (Princeton, New Jersey: MATHEMATICA Corp., September 1966).

¹²Murray A. Geisler and A. S. Ginsberg, *Man-Machine Experience* (Santa Monica: The Rand Corporation, P-3214, August 1965). (The Rand Corporation's leadership role in many of the activities discussed is considerable, and will be reflected in the references and examples cited throughout.)

¹³R. L. Chapman and John L. Kennedy, *The Background and Implications of the System Research Laboratory Studies* (Santa Monica: The Rand Corporation, P-740, 1955).

Center for the Computer Based Studies of Behavioral Sciences has in more recent years carried on that tradition.¹⁴

Free-form gaming involves teams and a referee group operating within the framework of a scenario. If computational equipment is used at all, it is often relegated to a simple bookkeeping role. Of the four types, this is the least amenable to tight technical control; however, it is the most likely to produce an impressive array of new insights into complex problems as a result of the "playful" and often open-ended course that the free-form game is capable of taking. Free-form gaming is also the least expensive, receives far and away the most publicity, and is often done at the highest policy levels.¹⁵ It is a form of activity that could be exploited to a far greater extent than it has been in the past, a point to which we return below.¹⁶

¹⁴Others could also be noted. For instance, the Management Science Laboratory at the University of California at Berkeley; NEWS, the Naval Electronic Warfare Simulator, at Newport, Rhode Island; the POLIS Laboratory at the University of California at Santa Barbara; and many others. See Shubik, Brewer, and Savage, *op. cit.*, pp. 24-26, for a more complete listing.

¹⁵The classic statement of the genre is Herbert Goldhamer and Hans Speier, "Some Observations on Political Gaming," *World Politics*, Vol. 12 (October 1959), pp. 71-83.

¹⁶The fact that free-form games have slighted several important scientific requisites has been presented as one basic reason for inattention; the matter is resolvable, however. See Martin Shubik and Garry D. Brewer, "Methodological Advances in Gaming: The One-Person, Computer Interactive, Quasi-Rigid Rule Game," *Simulation & Games*, Vol. 3, No. 3 (September 1972), pp. 329-348.

III. PURPOSES OF GAMES

The need to define the purpose of a game carefully cannot be stressed enough. For instance, criteria for assessment or validation are related directly to the explicit purposes of a game, although the connection is rarely made in practice. One does not judge teaching games, where the intention is to impart a skill or to motivate students, as harshly or in the same way as an experimental game, where the intention is to generate scientific insights or to test theory.

Martin Shubik has differentiated six basic gaming purposes with examples of applications arrayed under each.¹⁷ His basic list includes teaching, experimentation, entertainment, therapy and diagnosis, training, and operations. In this thorough exercise, "forecasting" occurs only as one of eight possible applications under the general purposive heading of gaming for operations. Generally, operational games are used almost exclusively by adults in military, governmental or corporate organizations; their largest use, by far, is in the military and diplomatic-military communities. It is for this reason, among others, that many of the examples occurring throughout this chapter are drawn from these experiences. Relative to military and military-diplomatic uses, corporate operational gaming is insignificant, and the use of operational gaming

¹⁷ Martin Shubik, "On the Scope of Gaming," *Management Science*, Vol. 18 No. 5 (January 1972), pp. 20-36.

for social planning is infantile.¹⁸

Operational games have been used to *cross-check other techniques*, an application suited to the full exploration of a problem rather than reliance on a single, dominant method. Games may serve the unstated but important purposes of *extra-organizational communication* and mutual assessment. Busy decisionmakers may be as much interested in the personal styles of their bureaucratic and political colleagues and competitors in a game setting as they are in the topic, play, and manifest outcomes of the game itself. The tendency of the highest level American federal officials to participate in political-military games soon after a new administration comes to power--a tendency which soon and significantly attenuates--is an example.

Planning, exploration and testing represent a third operational use of games. Such games are characterized by elaborate, detailed preparatory activities, deliberate play where interesting questions raised are often set aside for detailed post-game analysis and reflection, and painstaking

¹⁸ Many of gaming's operational possibilities, including forecasting, have been discussed over the years. The works of Clayton J. Thomas, Walter L. Deemer, Milton Weiner, and Edwin Paxson are recommended particularly: Clayton J. Thomas and Walter L. Deemer, "The Role of Operational Gaming in Operations Research," *Journal of the Operations Research Society*, Vol. 5, No. 1 (February 1957), pp. 1-27; Milton G. Weiner, "Gaming," in E. S. Quade and W. I. Boucher, eds., *Systems Analysis and Policy Planning: Applications in Defense* (New York: American Elsevier, 1968), Chapter 14; and Edwin Paxson, *War Gaming* (Santa Monica: The Rand Corporation, RM-3489-PR, February 1963). Each of these individuals is a gaming professional of long and rich experience, and each has in his career made significant and creative contributions to the craft. As a crude indicator of the fragmentation of the field, however, odds are that few educational, experimental, or "academic" gamers have even heard of them, read any of their work, or know about their many contributions.

debriefing of all participants.¹⁹ To be productive, planning games should use the real people involved in the fine detail of the operations and contexts being scrutinized.

Eliciting group opinion and judgment is a fourth operational application, especially where decisions are not replicable. For example, in discussing strategic arms limitation, there is no way of testing the comparative advantage of complementary weapons systems to determine which of them are relatively more effective, liable to be launched successfully, or subject to a more positive command and control. The role of expert opinion in such situations is clear, and various group judgment techniques (among other methods) have been created in recent years that at least confront the issue. Such techniques may easily and correctly be viewed as a specialized form of gaming activity²⁰ in which present and forecast planning factors are elicited in a formal, game-like structure.

"Brainstorming" has been developed and used for forecasting and other operational applications with mixed degrees of success over the years.

Advocacy uses are often discernible in operational gaming activities. One need only recall the advocacy use of games in Japan's Total War Research

¹⁹ Many examples are known among professionals, and Edwin Paxson's X-RAY series of games is a clear case in point. See his "Computers and National Security," in *Computers and the Problem of Society* (New York: American Federation of Information Processing Societies, AFIPS, 1972), Chapter 3.

²⁰ Norman Dalkey and Olaf Helmer are readily identified with the creation and development of Delphi techniques. A recent summary of the status of Delphi is contained in N. C. Dalkey et al., *Studies in the Quality of Life: Delphi and Decision-making*, Lexington, Mass.: D. C. Heath, 1972).

Institute prior to Pearl Harbor to show how games could be used to bolster institutional or personal preferences.²¹

The *forecasting* use of operational games is slight as compared with these other possibilities. A key point is that a forecaster is likely to use a variety of methods to aid him in arriving at a *best* estimate of the future; however, the distinction between contingency planning and forecasting helps to explain why a variety of methods in addition to gaming should be used to make specific estimates.

A good operational game may make use of good forecasting procedures but it is not in itself aimed at providing forecasts. This should not be confused with its use in discovering new alternatives and in helping to evaluate future possibilities. *Forecasting and contingency planning* are related but extremely different activities. In particular, a good forecaster may not be in the slightest interested in the importance or worth of his forecast. Accuracy may be a goal for the forecaster in and of itself, not because of its relevancy to the planning process.

A game may be a useful device for stressing the need for coordination of forecasting activities with planning and decision-making processes. In this sense the involvement of forecasters in the design and play of operational games may be of considerable use.²²

This means that if one wants to make a point estimate of some future event, gaming is probably not the sole method of choice, although it may be a valuable supplement to alternative techniques. A game may tell one a great deal about the relative importance of events in some setting, their possible interactions, and a range of feasible and probable outcomes--and for all of these reasons, and more, it is important. However, the hard

²¹Roberta Wohlstetter, *Pearl Harbor: Warning and Decision* (Stanford: Stanford University Press, 1962), contains an account. The highly revealing debate before the U.S. Senate conducted by Albert Wohlstetter and George Rathjens on the Safeguard ABM system illustrates the point in more contemporary terms. The entire issue of *Operations Research*, Vol. 19 (September 1971), was devoted to this.

²²Martin Shubik, "On the Scope of Gaming," *op. cit.*, pp. 11-12.

specification of a single, most *likely* outcome--including its exact time and magnitude--is generally beyond the capacity of the method.

To exploit gaming's relative strengths and to minimize its actual weaknesses, we must reconsider our usual way of thinking about forecasting and projection.

IV. AN EXPANDED CONCEPTION OF PROJECTION

The general concept of projection commonly employed is ill-developed, and the following discussion raises several issues in an attempt to improve the current state of affairs.

Contextuality, Operations, and Creativity

If higher level analytic details cannot be deduced from statements about constituent parts, point prediction is not always possible. However, this strictly logical constraint ought not limit our impulses to anticipate and manage the future.

Contextuality. Emerging phenomena are unpredictable only in the strictly logical sense. Such phenomena can be anticipated using a consistent frame of reference or context.²³ Historians remind us that contexts are usually unique in specific details and hence making a point prediction can be a hazardous business. Key elements in a given context may never exactly reappear, thus creating great uncertainty that a given phenomenon will likewise reappear. Seeking relief from this uncertainty, one is led to rely on different approaches, to use a variety of methodologies, and to draw his conclusions from several distinct (but related) levels of analytic detail. It also means that all approaches, levels,

²³ This is precisely the message contained in Harold Lasswell's formulation and use of the "developmental construct," where the primacy of *contextual detail* is stressed to good effect. See his "Chinese Resistance to Japanese Invasion: The Predictive Value of Precrisis Symbols," *American Journal of Sociology*, Vol. 43 (1938), pp. 704-716; and the classic statement of the idea in his "The Garrison State," *American Journal of Sociology*, Vol. 46 (1941), pp. 455-468.

and methods should be set in as rich a context as possible.²⁴

Basically one attempts to concentrate on the "zones of probable contradiction or conflict," recalling an earlier comment from Lasswell, and to examine the factors underlying the zones of tension so that some understanding and estimation of likely outcomes follows. These are all context-dependent activities, and one should not expect to have much projective success without first having a great deal of detailed understanding about a specific setting.

Operations. The probability of an anticipated event actually occurring is relative to the state of theoretical knowledge, historical developments, and the purposes of those participating at each level of analytic resolution. Projections are subject to modification, deflection, or reinforcement in accordance with purposeful, manipulative steps, commonly referred to as policies. To be concerned about operational matters--as one presumes the gamer-forecaster is--is to be concerned about several related aspects of any specified context, e.g., operating goals, past trends, structural relationships, and implemented policies.

²⁴This is the issue considered in Harvey DeWeerd, "A Contextual Approach to Scenario Construction," *Simulation & Games* (September 1974, forthcoming). "A contextual framework helps one to exclude irrelevant materials and permits a concentration on the central problem under analysis. Unless one is dealing with present-day problems and can be assured that all members of a game or research team know precisely what the present situation is--and can agree on it--one needs a context to avoid wasting time in reaching a common approach to the subject. When dealing with future problems, it is even more desirable to have a context to provide a common understanding of what the particular future under consideration is like. Otherwise, each man will form his own ideas about the future and these ideas can vary widely, making group research or game efforts difficult." From the manuscript, same title (Santa Monica: The Rand Corporation, P-5084, September 1973), p. 1.

Projecting the future then is equivalent to figuring out what might happen in such a context if nothing is done to intervene, if ranges of plausible interventions are adopted, and if a single option is in fact taken.

Creativity. Resolving the problem of relating actual future events to the range of possible and plausible interventions concerns one's creative orientation to the subject, and anything that stimulates this orientation is to be encouraged. Given this broadened conception of projection, the analyst moves between thinking deeply about the narrow details of a context and synthesizing its fullest, most information laden, and complex forms. This process and its results are more an act of creativity than they are one of automatic forecasting. It is not an idle argument, but one prompted by several observable pathologies that plague current applications of gaming and closely related techniques.

Some Current Pathologies

Sometimes extraordinary emphasis is placed on specific outcomes of gaming exercises as *the* point of interest. The term "outcome" suggests a single, well-defined event to be compared, *post facto*, with a prior point prediction.²⁵ Shooting craps and betting on horses are activities amenable to this type of thinking about projection; forecasting complex behavior such as that encountered over long periods of time in an international setting is not.

²⁵D. R. Hitchcock, *A Note on Evaluating Operational Gaming* (Santa Monica: System Development Corporation, SP-40, October 16, 1958) treats this concept in making comparisons between games for operational, demonstration, research, and training purposes.

Methodological Deformations. Noticeable success with a given method, regardless of the purpose at hand, tends to produce an urge to apply it in all subsequent situations, appropriate or not. In the end the method often becomes an obsession. Faithful technicians set up schools to propagate the method among true believers, and throughout the separation of the method from its original successful application is lost. The extension of some interesting methodological ideas developed in an industrial setting to encompass the world is one clear case. One finds little to quibble with in Jay Forrester's early probings of the Sprague Electric Company with a method which has since come to be known as "system dynamics"; however, his and others later efforts to capture the world with the same method have drawn fire from many quarters.²⁶ Science is sometimes perverted to the propagation of means, and the original end, the desired objective, is quickly forgotten. A single-minded concern for the technical mechanisms of a given game or model is one unhappy manifestation of this tendency.²⁷

²⁶The early work is Jay W. Forrester, *Industrial Dynamics* (Cambridge: The MIT Press, 1961); the later efforts include, Forrester, *World Dynamics* (Cambridge: Wright-Allen Press, 1971); and Donella H. Meadows et al., *The Limits to Growth* (New York: Universe Books, 1972). Criticism has come from many sources; however, that produced by the "Sussex Group" under the leadership of H. S. D. Cole merits special attention for its thoroughness. See H. S. D. Cole et al., eds., *Models of Doom: A Critique of the Limits to Growth* (New York: Universe Books, 1973).

²⁷H. Bull, "International Theory: The Case for a Classical Approach," *World Politics*, Vol. 18, No. 3 (April 1966), pp. 361-377, states the case well in arguing that technique-intensive efforts to understand international contexts have "succeeded in providing figures only to be blinded by the illumination they cast" (p. 374). What he objects to most is the simplification inherent in any MSG and the failure of the methods-oriented theorist to occasionally make connections with the real world. His point is often valid.

If one is willing to accept our expanded conception of projection, then a harsh demand for strict empirical validation of one's projective efforts seems somewhat out of place. We engage in projection primarily to explore contingencies; we do not, accepting the creative premise and purpose, strive to make hard, point estimates--which are probably out of reach anyhow. Particularly in international relations forecasting the distinction is not subtle, but fundamental.

Even the predictive excellence of physical theories, the model from which we take many of our professional cues, and the relationship of empirical investigation to insightful and creative breakthroughs in the "harder" disciplines are not always as great or as direct as natural scientists would lead others to believe. Thomas Kuhn's work on scientific paradigms is directed exactly to these points; others could be mentioned.²⁸ Furthermore, in those cases where a direct connection between one's rigorous method, empirical findings, and conclusions seem to have been made, this often proves illusory. Recent efforts of "decision theorists" to predict individual level behavior using advanced applications of Bayesian statistical techniques have evoked a great deal of attention within both research and policy communities. However, the connections made between the decision theoretical corpus and the findings generated uniformly concern *highly selected* aspects of the empirical settings, and

²⁸ Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1964 Phoenix edition); and Jean Rostand, *Error and Deception in Science* (New York: Basic Books, 1960),

the implications following from such selections are seldom acknowledged.²⁹

It is sometimes argued that such assumptions [a general reference to the problem considered here] are made for "analytical convenience," and the results must, of course, be interpreted in a larger context. This argument would be valid if, in fact, the problems of interpretation in a larger context were regularly considered and addressed; but they seldom are.³⁰

This is not to deprecate the efforts of decision theorists to advance viable and reliable predictions; it is to stress the fundamental problem that arises when one demands hard, point estimates in an environment where such estimates are not likely to be forthcoming.³¹ It further stresses the importance of taking an expanded view of projection and the need for a more creative and open approach to the basic problem:

²⁹Harold W. Kuhn stresses this matter in the context of negotiations and points out that game theoretic efforts abstract out essential aspects of an empirical context and assumptions made in the interests of theoretical tractability produce results that are insufficiently detailed. The blame, in Kuhn's view, is shared by game theorist and behavioralist alike. "Game Theory and Models of Negotiation," *Journal of Conflict Resolution*, Vol. 6, No. 1 (March 1962), pp. 1-4. An excellent general source is Howard Raiffa, *Decision Analysis* (Reading, Mass.: Addison-Wesley, 1968); a detailed technical statement is contained in P. Slovic and S. Lichtenstein, "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment," *Organizational Behavior and Human Performance*, Vol. 6 (1971), pp. 649-744.

³⁰Ralph Strauch, "Winners and Losers: A Conceptual Barrier in Our Strategic Thinking," *Air University Review*, Vol. 23, No. 5 (July-August 1972), pp. 33-44, at pp. 38 f.

³¹The literature here is burgeoning, but one early and well-presented man-machine example is L. W. Miller, R. J. Kaplan, and W. Edwards, *JUDGE: A Value-Based Tactical Command System* (Santa Monica: The Rand Corporation, RM-5147-PR, March 1967). In this case, one gets a sense of one area where decision theorists have been relatively successful. The question, and it is moot, is whether international relations contexts are sufficiently congruent with that exemplified by JUDGE to allow easy transference of the theories and methods. Insufficient results exist to make the judgment.

understanding and projecting a variety of likely and plausible contingencies for specified contexts.

Deformation of the Level of Analysis. A related point is suggested by efforts to forecast system level outcomes based primarily on individual level information. Naively mixing levels of analytic detail deforms this task--a deformation that is at least addressed in contextual efforts to game.

One must make distinctions between the different levels of analytic detail that may be operating in a given setting. For instance, categories such as the following have been used to do this: *individual level detail*, including studies of elite behavior, in-depth psychological studies of key individuals, and psychological profiles containing extensive background information about the socialization of ruling and key decision-makers;³² *group or institutional interactions*, including crisis behavior, comparative studies of relevant decisionmaking bodies, and inter-organizational studies;³³ *national level analyses*, including (disreputable) "national

³²A durable example of this kind of work is contained in Harold D. Lasswell and Daniel Lerner, eds., *World Revolutionary Elites: Studies in Coercive Ideological Movements* (Cambridge: The MIT Press, 1965), especially the substantive chapters on the Politburo, the Fascists, the Nazi elite, and the two Chinese elites--the Kuomintang and the Communists. Alexander L. George and Juliette L. George, *Woodrow Wilson and Colonel House: A Personality Study* (New York: John Day, 1956), is an example of a detailed personality assessment that could conceivably be developed as a complementary activity to the actual play of a game in which the actions of key figures dominate. To the author's knowledge, such has not been done, although the possibilities are fascinating to speculate on.

³³Graham T. Allison's well-known *Essence of Decision* (Boston: Little, Brown, 1971) has many of the requisite characteristics for this level of analysis; and Nathan Leites, *The Operational Code of the Politburo* (New York: McGraw-Hill, 1951), is another excellent case in point.

In the gaming setting, this level of detail has been studied experimentally. One example is A. Binder, "Learning and Extinction of Leadership Preferences in Small Groups," *Journal of Mathematical Psychology*, Vol. 3 (1966), pp. 129-139; and another is the so-called "risky shift" phenomenon reported in M. A. Wallich and N. Kogan, "The Role of Information, Discussion, and Consensus in Group Risk Taking," *Journal of Experimental Social Psychology*, Vol. 1 (1965), pp. 1-19. The connections between these experimental games and operational-forecasting efforts are tenuous.

character" studies, and macroprocess studies;³⁴ and finally, *international relations*, comprising much of the literature so identified.³⁵

Alternative and complementary dimensions exist with which to structure the level of resolution or detail and include the following: *temporal*,³⁶ *spatial*,³⁷ and *military-operational* (in which spatial and temporal concepts are related to specific activities, e.g., engagements, battles,

³⁴Margaret Mead, *Soviet Attitudes Toward Authority* (New York: McGraw-Hill, 1951); Hadley Cantril, *Human Nature and Political Systems* (New Brunswick, New Jersey: Rutgers University Press, 1961); and Seymour M. Lipset and Leo Lowenthal, eds., *Culture and Social Character* (New York: The Free Press, 1961), all exemplify attempts to work with this style and level of analysis. The idea of "national character" has gained common coinage; however, it is for the most part meaningless, even mythical, derived from the most casual of observations.

³⁵G. Modelski, "Simulations, 'Realities,' and International Relations Theory," *Simulations & Games*, Vol. 1, No. 2 (June 1970), pp. 111-134, takes as a point of departure some of the limitations of the Inter-National Simulation (INS) with respect to monolithic assumptions made about the analytic unit "nation" and develops some alternative and supplementary model building strategies. L. P. Bloomfield, *Anticipating Conflict-Control Policies, The "Conex" Games as a Planning Tool* (Cambridge: M.I.T. Center for International Studies, C/70/10, February 1970), discusses the possibilities of predicting policy behavior using free-form gaming techniques with specific attention to multi-lateral and great power relations as well as arms control issues.

³⁶S. A. Boorman, *The Protracted Game* (New York: Oxford University Press, 1969), presents a fascinating account in gaming terms of the Chinese Communists' rise to power. The timing and general conceptions of play contained in the board game *Wei-ch'i* (Japanese *Go*) are relied on as the descriptive and explanatory analogy, and done so with impact. A more technical discussion of the importance of time in model building and use is R. E. Nance, "On Time Flow Mechanisms for Discrete System Simulation," *Management Science*, Vol. 18, No. 1 (September 1971), pp. 59-73, in which the basic ideas of timing moves by "fixed" and "event" clocks are carefully laid out.

³⁷Board and map maneuver games typify an emphasis on this level of analysis. Francis J. McHugh, *Fundamentals of War Gaming* (Newport, R.I.; U.S. Naval War College, 1966, 3rd edition), is one of the most comprehensive summaries of the type.

wars, campaigns).³⁸ Various dimensions and associated level are consistently and erroneously mixed in practical application, and we must be continually aware of differences in structure, process, and behavior of each conceptual dimension and between each of the representative levels of analysis.

This is a serious problem having grave consequences for those who must make estimates and decide policy involving vast resources.³⁹ To oversimplify, the problem appears partly to be a misapplication to the institutional level of methods, theories, and techniques of analysis that are more appropriately used to study individual level details.⁴⁰

³⁸ Shubik and Brewer, Rand Report R-1060-ARPA/RC, *op. cit.*, is a recent summary; and W. R. Livermore, *The American Kriegsspiel: A Game for Practicing the Art of War Upon a Topographical Map* (Boston: W. B. Clarke, 2nd edition, 1898), is a specific, venerable example.

³⁹ One policymaker has summed the matter up in the following terms with respect to forecasting bureaucratic behavior: "Until it is possible to understand, much more completely than we do now, the decisionmaking process within typical military bureaucracies, it is doubtful that we can do an effective job of forecasting likely future military postures beyond those relatively few years into the future, during which the inertia and commitment implied in current posture and current program decisions decisively determine the future posture. In other words, forecasts for planning purposes and estimates which involve implicit estimates of military power beyond about four to five years in the future require an understanding of the decisionmaking behavior of military organizations that we do not have. To continue to rely to any extent on the notion that such organizations have a well-defined consistent set of objectives which they seek to attain with fairly optimal expenditure of resources given them by their government is seriously in error." Andrew Marshall, *Problems of Estimating Military Power* (Paper read at the Annual Meetings of the American Political Science Association, 1966), pp. 21-22.

⁴⁰ In my opinion, this is one of the nagging problems of several of the more popular free-form gaming activities. In a game setting where individual level activities are undertaken and observed, there is little reason to make the considerable inferential leap to speculate on aggregate institutional behavior not actually observed in game play. In W. J. Crow, "A Study of Strategic Doctrines Using the Inter-Nation Simulation," *The Journal of Conflict Resolution*, Vol. 7, No. 3 (September 1963), pp. 580-589, one is given a very good example of this problem; and in L. P. Bloomfield, "After Neo-Isolationism, What?" *Bulletin of the Atomic Scientists*, Vol. 27 (April 1971), pp. 9-13, major institutional problems are discussed whose solution, it is suggested, could be worked out by playing games that have typically stressed the individual level of detail.

As is patently obvious upon examination of the various examples presented in conjunction with different levels of analysis, each level requires different kinds of data, different analytic methods, and different research "styles." While we need to be conscious not to mix them indiscriminately in making forecasts or projections, the demand for systematic methods and techniques to integrate these analytic perspectives is acute. Carefully and conscientiously employed, gaming may have a distinct role to play in this regard.⁴¹

Deformations of Simplification. Three simplifications commonly occur in efforts to conduct operational gaming for forecasting and related applications: (1) Treating a simply structured gaming device as if it were reality itself rather than only a substitute for, or perspective of, reality;⁴² (2) assuming symmetrical configurations of opposing teams or forces;⁴³ and (3) selecting rather narrowly from among the set

⁴¹The difficult matter of selecting an appropriate method to forecast international relations settings is addressed in R. H. Davis, "Arms Control Simulation: The Search for an Acceptable Method," *Journal of Conflict Resolution*, Vol. 7 (1963), pp. 590-602. Davis suggests that small, well-defined aspects of the arms control issue might be studied under laboratory or experimental conditions, but the broader, more inclusive topic will most likely defy conventional or single-purpose analytic treatment. His argument follows closely one developed earlier in this chapter: for complex settings, one will probably have to rely on a number of methods and techniques to begin to understand the context sufficiently well that informed judgments about the future may begin to be made. Martin Shubik and the author deal with this explicitly in our "Methodological Advances in Gaming . . .," *op. cit.*

⁴²A. Flook, "Simulation Studies of International Conflict," *Simulation*, Vol. 14, No. 4 (April 1970), pp. 181-184, raises the appropriate questions in this regard.

⁴³One example of the mischief that this assumption can cause is presented in H. Hatry, F. Jackson, and P. Lever, *TEMPO Military Planning Game: Description and Discussion* (Santa Barbara: G. E. TEMPO, May 1962). The difficulty is more commonly seen in verbal rationalizations presented to the Congress in support of generally increased expenditures or in support of a specific weapons system.

of candidate topics for inclusion in one's games and models.⁴⁴

Games by definition are abstract simplifications. This fact is routinely overlooked in the course of game design, play and use, and the results have been detrimental for projective applications.⁴⁵

Resources are often employed in game settings far better than in the real world, leading to inflated expectations about future levels of performance and efficiency. Institutional structures, introduced into the game setting as a "given," are frequently eliminated or severely modified in the interests of game play, leading one to presume that moribund, inert, and intractable institutions could be simply managed in the real world.⁴⁶ Again, expectations about future performance far outstrip the maximum feasible levels of effort expected by the most optimistic of "reasonable men." Time rates of change of gamed or modeled elements are accelerated unrealistically in the game setting,

⁴⁴There is an understandable, but unfortunate, tendency in many military games to stress quantifiable elements to the virtual exclusion of non-quantifiable but important ones. Hence in the Shubik and Brewer survey of activity in the Department of Defense in 1971, less than 1 percent of all models surveyed dealt with international relations and/or political-diplomatic-military purposes.

⁴⁵W. J. Crow and R. C. Noel, *The Valid Use of Simulation Results* (La Jolla, Calif.: Western Behavioral Sciences Institute, June 1965), have considered this situation in terms of players' psychological attributes, the social context of game play, and the nature of the simulated situation confronted. At base were concerns for a game's purpose and the kind of players used in a free-form situation. Both concerns have been ill-appreciated for the most part by advocates and users of free-form, international relations games for forecasting and policy purposes.

⁴⁶Both TEMPER and World Dynamics illustrate this contention. For the former, M. Balinski et al., *Review of the TEMPER Model . . .*, *op. cit.*, and for the latter H. S. D. Cole et al., eds., *Models of Doom . . .*, *op. cit.*, make the appropriate comments.

creating false perceptions of the actual rates of change attainable in the operational setting.⁴⁷

There will always be discontinuities between the gamed or modeled setting and its reference system; however, being common and persistent, they generally impede improved applications of operational games. The difficulties presented by these factors in any given application are primarily a function of the skill and experience of the analyst-gamer responsible for the work.

The concept of symmetry is well enough known in gaming circles; at its simplest, it means that opposing teams are equivalently structured and endowed. However, less well known are the simplifications that flow directly from careless reliance on the concept, particularly in the areas of forecasting military force postures and structures.⁴⁸ With respect to current discussions of Mutual and Balanced Force Reduction, for example, symmetry assumptions could very easily lead one to the conclusion that equivalent reductions in forces would have approximately equivalent effects on either side; of course, this overlooks the fact that a Soviet

⁴⁷ In his critical, annotated bibliography, M. Patchen, "Models of Cooperation and Conflict: A Critical Review," *Journal of Conflict Resolution*, Vol. 14, No. 3 (September 1970), pp. 389-407, touches on this problem, especially in the two sections labeled "Models Predicting Influence Behaviors," and "Reaction Process Models." The issue is treated well and somewhat differently in Norman C. Dalkey, *Central Nuclear War Games* (Santa Monica: The Rand Corporation, P-3437, 1966), where the concepts of *payoff*, *criterion*, and *complexity of the representation* are all discussed. It should also be noted that these problems are seldom handled in a forthright manner in typical game representation and play, with harmful consequences for forecasting and other purposes.

⁴⁸ A rigorous technical treatment is contained in R. Issacs, *Differential Games: A Mathematical Theory with Applications to Warfare and Pursuit, Control and Optimization* (New York: John Wiley, 1965).

division removed from Poland only travels across a border, while an American division removed from West Germany ends up some 4000 miles from the scene. The impact of symmetry assumptions in Strategic Arms Limitation Talks (SALT) is reflected in the fact that a Soviet missile or weapon system is not equivalent to an American one, and crude "numbers games" matching absolute amounts of missiles and warheads tells one very little about either the weapons or their relative effectiveness.

The problem is easily seen in the gaming context where, given an imagined or predetermined number and configuration of the opposing force, maintenance of symmetry compels one to have a proportionate or equivalent number and configuration.⁴⁹ The most obvious result of such simplification in the real world has been a rather unimaginative tendency to progress in lock-step fashion with one's imagined foe of the moment; innovations, as achieved in research and development initiatives, tend to focus on "keeping up" or "staying ahead" by making marginal adjustments to the current hardware and forces and resisting basic changes in extant procedures, tactics, strategy, or doctrine. At base is the simplifying (and distorting) concept of symmetry.⁵⁰

The selection of topics for inclusion in one's games or analyses is a third source of simplifying distortion. The act of selection implies that the topics chosen are relatively more important and that items

⁴⁹ Melvin Dresher, *Some Military Applications of the Theory of Games* (Santa Monica: The Rand Corporation, P-1849, 1959), contains some very clear examples of this point.

⁵⁰ Andrew Marshall, *op. cit.*, is one rare example where the concept has been appreciated, both in gaming and operational terms.

omitted are of less value. The problem of selection is not an abstract or simply "academic" one. In our survey of the active inventory of 132 operational models, simulations, and games in the U.S. Department of Defense inventory at the end of 1971, we found only one listed as having a political-diplomatic-military/international relations primary purpose. Given present-day concern over SALT, the Middle East, and the expansion and clarification of Sino- and Soviet-American relations, this is a startling finding.⁵¹ By far the bulk of MSG activity is devoted to all-computer technical evaluations and force structure analyses. Technical evaluations turn out to be weapon system evaluation, most accurately characterized as "value-free" engineering work, where the selection process has operated vengefully to exclude many important but hard-to-quantify components.

⁵¹Shubik and Brewer, *Models, Simulations, and Games* . . . , *op. cit.* pp. 16-17.

V. SOME FUNDAMENTAL QUESTIONS

Several even more fundamental questions and issues related to gaming have received little or no attention by responsible professionals. This is not only surprising, but inhibits the development and productive utilization of the various types of gaming and closely related methodologies for serious operational and research purposes.⁵² It is through careful attention to the fundamentals that progress toward improved forecasting with games may one day be realized to a greater extent than at present. For this reason, primarily, a few of the fundamentals are spelled out in the following section.

There is nothing approximating a distinct theory of gaming, as distinguished from game theory, decision theory, small group theory, or any one of a number of theoretical paradigms. There is also no serious scholarship devoted to the exploration of the limits and validity of the knowledge--or the epistemology--generated by modeling, simulating, or gaming. For instance, how might one go about identifying and then comparing the underlying, implicit theories involved in models, simulations, and games? Everyone works with simplified representations of contexts as those found in the international relations sphere; the question focuses on the need for systematic ways to expose and then compare the simplifications that

⁵²R. C. Snyder, "Some Recent Trends in International Relations Theory and Research," in Austin Ranney, ed., *Essays on the Behavioral Study of Politics* (Urbana: University of Illinois Press, 1962), pp. 103-171, conducted a parallel exercise and noted with respect to many "fundamental" questions, "Hopefully we stand at the threshold of a period of further efforts to give greater depth and breadth to the configuration of hypotheses and applications of conceptual schemes" (p. 118). I fear Snyder was too optimistic, for, some twelve years later, the work has scarcely begun.

are actually being used to make forecasts. At the current state of knowledge, games are more likely to yield insights than to solve a problem directly; however, no one is certain about what game players and builders actually are "getting out" of the play or construction activity. It is an empirical problem, the resolution of which would improve game construction and play for many purposes, forecasting included.

A common feature of nearly all gaming activities is the scenario.⁵³ Scenarios range in style and complexity from the elaborate, fully articulated version often used in free-form games to implicit scenarios embedded deeply within hard, all-machine models. Little is known about the differences a scenario makes for game play and outcomes. Even less is known about what constitutes a "good" versus a "bad" scenario. However, these matters may be investigated, although very little effort has to date been expended. For example, what differences are caused in game play and outcomes when teams play a common scenario, scenarios based on inferred perceptions of one another, or scenarios with excessive "noise" or other diversionary

⁵³ The following represents a variety of work that has been done in the areas of scenario construction and applications: Harvey DeWeerd, *Political Military Scenarios* (Santa Monica: The Rand Corporation, P-3535, February 1967); idem, *An Israeli Scenario for a Laboratory Simulation* (Santa Monica: System Development Corporation, SP-3139, March 1968). The first is a survey of the state of the art by one of the trade's master scenarists, and the second is a five year forecast of Middle East events (1968-1973) which is striking for its plausibility and the extent of its accuracy in "calling the shots." Other examples of scenarios include Lincoln P. Bloomfield, *Western Europe to the Mid-Seventies: Five Scenarios* (Cambridge: MIT, Center for International Studies, A/68-3, 1968); Nigel Hawkes, "The World in 2020," *Nature*, Vol. 218 (April 6, 1968), pp. 14-16; Herman Kahn, *Alternative World Futures* (Hudson Institute, Paper HI-342, April 1964); C. K. Ogden, *Bentham's Theory of Fictions* (London: Kegan-Paul, 1932); Herman Kahn, *On Escalation, Metaphors, and Scenarios* (New York: Frederick A. Praeger, 1965); and Peter DeLeon, *Scenario Designs: An Overview* (Santa Monica: The Rand Corporation, R-1218-ARPA, 1973).

elements embedded in them?⁵⁴ The problems of perception and signaling are fundamental in the international context, but we have not yet undertaken enough systematic investigation of these topics to know with certainty just how much or how little impact different versions of the same situation will have on game and realistic outcomes. The critical importance of these matters for forecasting decisions in an international bargaining or negotiation setting is clear, but apparently little appreciated.

Given the extraordinary time and resources devoted to all-machine, "engineering-like" MSGs, one should be able to expose the implicit scenarios built into these representations to understand them and to begin to assess whether and in which ways the scenarios have distorted the models. Not only is this seldom done, but because of a number of technical and management problems related to documentation and secrecy, it is usually not possible to recreate the images and assumptions that underlie most quantitative MSGs. The user, as a result is frequently faced with a "take it or leave it" situation which makes questioning the forecasted results of many operational MSGs problematic at best.

Confusion of purposes has intruded on scenario construction and stimulated subsequent abuse. For example, in Herman Kahn and Anthony Weiner's *The Year 2000*,⁵⁵ an exercise in speculation with basic research

⁵⁴ See Robert Jervis, *The Logic of Images in International Relations* (Princeton: Princeton University Press, 1970), for a rare, thorough treatment of the general issue. The relationship of risk taking behavior to perception is admirably handled in Fred C. Iklé's *How Nations Negotiate* (New York: Harper & Row, 1964).

⁵⁵ Kahn and Weiner, *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years* (New York: Macmillan, 1967).

purposes, Japan's role in future international relations was noted as becoming third only to the United States and the Soviet Union; however, the scenario upon which this forecast was based made some important assumptions, e.g., with respect to world stability and the likely growth of natural resources, which many Japanese operators either did not appreciate or chose to ignore in leaping to the questionable conclusion that Japan would *in fact* become the third most powerful nation in the world by 2000. This example calls attention to an important, unresolved, and fundamental question: How does one safeguard against eager users taking a scenario originally intended for a narrow research question and promoting it to support some point of view or choice already taken by other means? No one knows, and the question is ripe.

A basic point is that we know almost nothing about the effects of a scenario, but we do know that as long as scenarios are regarded merely as aids to research and operational problem solving and not as valued entities in themselves, we are not likely to make much progress in developing and using the scenario methodology.

Citing some of the fundamental problems associated with scenarios calls attention to the more general deficiency of institutions and procedures to control, monitor, and evaluate the construction, developing and use of models, simulations and games. It is an unhealthy situation and deserves consideration as to who should be responsible, what institutions need to be created or changed to ensure faithful and valid operation and use, and what sorts of incentives should be structured into the present system to alleviate many current abuses. This is a major message contained in the results reported for the Shubik and Brewer survey

of operational MSGs in the Department of Defense, and hence it encompasses many devices being used for forecasting purposes.

Another fundamental question, or more correctly a collection of questions, concerns the uses or applications made of MSGs. It appears that many operational MSGs are built after decisions are made, that is, the devices are used to justify choices made for other reasons by other means. Applications of games and related techniques to policy problems have received inadequate professional attention. The over-enthusiastic use of methodologies (particularly where quantification is involved) has been caused, to a certain extent at least, by inattention to limitations of the methodologies and to difficulties of interpreting results of the analysis of problems whose quantifiability is itself subject to question.⁵⁶

⁵⁶ An important treatment of these matters is contained in Ralph E. Strauch, *A Critical Assessment of Quantitative Methodology as a Policy Analysis Tool* (Santa Monica: The Rand Corporation, R-1423-PR/ARPA, 1974 forthcoming).

VI. GAMING PROSPECTIVE: SPECIFIC DIRECTIONS FOR RESEARCH

As the foregoing partial recitation of fundamental, unresolved questions indicates, the determination of a list of research topics easily becomes an open-ended task, and the list's overall utility correspondingly decreases. What follows is a brief characterization of a few topics that appear especially susceptible to research probings and where the interconnection of gaming, forecasting, and international relations is pronounced.

Size

There is generally only the slightest appreciation for the effects of game size on the construction and operation of models, simulations, and games, and there is even less understanding of the effects of size on applications.⁵⁷ Is it better, for instance, to build small, simple, and easily understood MSGs (such as those currently referred to as "elementary process models" by Ithiel Pool and his associates), knowing full well that they are not "realistic," or should one opt for large, highly detailed, complicated devices that purport to capture reality? Those electing the former point of view have implicitly adopted the old modeler's dictum to "model simple and think complex"; it is difficult to

⁵⁷ Besides TEMPER, where the problem has already been noted, consider the "Air Battle Model," a major activity that evolved into a specialized supporting institution within the Air Force command structure in the 1960s. See R. H. Adams and J. L. Jenkins, "Simulation of Air Operations with the Air-Battle Model," *Operations Research*, Vol. 8 (September-October 1960), pp. 600-615. The basic problem, that of constructing huge, impossible to understand, MSGs continues, although the paucity of available documentation masks the practice. One exception is CODE 50, which was still operational in 1971. See J. H. Bick and H. Everett, *CODE 50: A Multi-Weapon, Multi-Target Nuclear Exchange War Game* (Paper presented at AMRAC Proceedings, ARPA: Project Defender, November 1967) (Unclassified).

identify the philosophy of those building and using the larger devices, much beyond saying that reality is not easily or cheaply captured in a black box.

Data Bases: Validity and Control

Very little attention has been given to data validation. All too frequently a set of data is used commonly by a large number of diverse operators without their giving adequate thought to whether the data are suitable to a specific application.⁵⁸ Validation has become an article of faith justified by such familiar expedients as saying that a data source is the only one known to exist, others use it in "similar" activities, collecting data is too time consuming and expensive, or the data, it is claimed, have become "standards" for the generation of planning factors or estimates.

The control of data bases has also not received adequate attention. In international relations, the best known data base management system is probably the U.S. State Department's CASCON,⁵⁹ but it is still in the development or earliest implementation stages. We do not know yet, in straightforward terms, whether the system works for State Department decisionmakers or not.

⁵⁸ Shubik and Brewer, *Models, Simulations, and Games* . . . , *op. cit.*, pp. 35-37.

⁵⁹ See Lincoln P. Bloomfield and Robert R. Beattie, "Computers and Policy-making: The CASCON Experiment," *Journal of Conflict Resolution*, Vol. 15 (1971), pp. 33-53; and Raymond Tanter, "International Systems and Foreign Policy Approaches: Implications for Conflict Modeling and Management," *World Politics*, Vol. 24 (1972), pp. 7-39.

Ex Post Facto Reconstructions

One productive way to answer the question, "How good have games been in forecasting international relations?" is to conduct *ex post facto* analyses of the game play and outcomes and make comparisons with realized events. Better information about appropriate game use will certainly result; more importantly, such reconstructions might clarify erroneous assumptions made in the *a priori* setting, sort out good from bad forecasters and forecasts, and improve the future use of games and related projective methodologies.

Many of the observations reported in the above section, "Some Current Pathologies," were derived from a rather unsystematic *ex post facto* summary of a large number of games. There is no reason why this kind of work could not be done routinely. If assumptions about a supposed opponent's decisionmaking processes yield consistently incorrect results in a number of gamed and modeled situations, there is an obvious need to reexamine those assumptions. If past exercises produced incorrect results because of the embedded assumptions, there is good reason to believe that prospective analyses and exercises will continue to do so.

Terrorism

Several common structural features of the act of terrorism might lend themselves to game or game-like treatment. The "players" in the terror "game" may include any or all of the following: audience, terrorist, victim, media, spectator, authorities, allies, and sanctuaries. The separate phases of the terrorist act, i.e., the "play" of the game, include the following: preparation, execution, climax, and dénouement.

Such a structural framework could serve the very useful purposes of organizing much of the existing, fragmented case study literature on terrorism and of understanding terrorism's many forms and processes so that preventive and ameliorative policies might be developed.⁶⁰

Deception Games

Deception has been a normal matter in the practical conduct of international affairs; surprisingly, scholars have not directed their full attention to this topic in recent times.⁶¹

Deception might be tackled with gaming techniques by first beginning to build up a contextual base of information of those instances in international affairs where deception has been employed. There is some literature on this, particularly Barton Whaley's almost single-handed efforts of the last five years.⁶² One could move from these beginnings to the creative tasks of figuring out ways to practice deception better, more effectively, and more efficiently, and hence, figuring out what might be done to counter the typical forms discerned

⁶⁰This section on terrorism was suggested in conversation with Abraham Kaplan in August 1973. He is carrying out some of the initial investigations implied in the formulation.

⁶¹Roberta Wohlstetter's excellent work, *Pearl Harbor: Warning and Decision*, *op. cit.*, failed to stimulate very much activity in the area, despite the many research leads she left.

⁶²Whaley's *Codeword BARBAROSSA* (Cambridge: The MIT Press, 1973), has received deserved public attention; however, his massive *Strategem: Deception and Surprise in War* (Cambridge: MIT, Center for International Studies, CIS-C/69-9, 1969) provides the gamer interested in deception with a veritable gold mine of pertinent information.

⁶³ In history. Because the creative aspect of gaming combines systematic with more speculative purposes and procedures, it seems to be one excellent methodological vehicle for this sort of activity.

Crisis Games

Extraordinary actions may become plausible in a crisis, but this does not mean that more, more interesting, or better actions present themselves. On the contrary, one of the major consistent findings of crisis analyses is that the number and variety of options rapidly diminish in the short- to no-lead time, high-stakes situation.⁶⁴ In fact, one of the prime objectives of crisis analyses is to figure out ways to expand the set of feasible and plausible options available to decisionmakers.⁶⁵

One might also view Graham Allison's study of the Cuban missile crisis as a gaming exercise.⁶⁶ The construction of his three explanatory

⁶³ The second task has been undertaken with some interesting preliminary results in William R. Harris, *On Countering Strategic Deception* (Santa Monica: The Rand Corporation, R-1230-ARPA, 1974 forthcoming). Besides coining the clever label "sprignals"--meaning "spurious signals"--another interesting feature of both the Whaley and Harris works is that they have been developed entirely with open, published sources, i.e., deception is not necessarily an ethereal topic whose development and clarification need be hamstrung by classification restrictions.

⁶⁴ A broad treatment is contained in Alastair Buchan, "Crisis Management: The New Diplomacy," *The Atlantic Papers* (Paris: The Atlantic Institute, 1966); for a simple, experimental analysis of the issue see my "Analysis of Complex Systems: An Experiment and Its Implications for Policymaking," in Todd R. La Porte, ed., *Organized Social Complexity: Challenge to Politics and Policy* (Princeton: Princeton University Press, 1974 forthcoming).

⁶⁵ Two concise statements are contained in Harvey A. Averch and M. M. Lavin, *Dilemmas in the Politico-Military Conduct of Escalating Crises* (Santa Monica: The Rand Corporation, P-3204, 1965); and Ole R. Holsti, "Crisis, Stress, and Decisionmaking," *International Social Science Journal*, Vol. 23, No. 1 (1971), pp. 53-67.

⁶⁶ Graham T. Allison, *Essence of Decision*, op. cit.

models was a creative and successful attempt to develop alternative decisionmaking scenarios. One of the major "findings" of the work was that there were too few options available to the relevant decisionmaking participants, e.g., bombing the Cuban missile sites had far less to recommend it when the chips were down than when it was considered in military contingency plans. In short, creativity inherent in the use of gaming as an option-generating device had largely been ignored in the pre-crisis period with the result that decisionmakers had to "play it by ear" far more than they should have when the crisis actually unfolded. Gaming techniques, e.g., the specification of assumptions, the structuring of the flow of likely and consequent events from those assumptions, and the examination of alternative assumptions, structures, and so forth, have something to offer to improve these matters.

Termination Games

It has been argued that insufficient thought is ordinarily given to the different ways in which hostilities might end. The process of war is seldom considered from its initiation to its eventual and likely conclusions.⁶⁷ Several distinct topics shed light on this most overlooked of the phases of war. The first relates to understanding the characteristic decisionmaking styles of those thought most likely to be involved in war termination. The second concerns systematic comprehension of the negotiation strategies and tactics used by politico-military authorities.

⁶⁷Fred C. Iklé, *Every War Must End* (New York: Columbia University Press, 1971), must rank as one of the most important and underrated books of the past few years.

The third focuses on the kinds of communication, command, and control apparatus that would be depended upon to wage and then terminate a war. The fourth, and perhaps the most important, task is figuring out ways to end a war before it begins, and failing that, to end the war at something less than total destruction of the hostile parties.

Each of these topics may be discussed with respect to gaming's potential contributory role. This is done below to stress the importance to forecasting of termination games, to indicate the kind of thinking which should be applied to each of the foregoing research tasks--but which has been omitted from this summary, overview treatment--and to summarize the main themes and arguments of the chapter through examples of a gaming-based, prospective research outline.

While credible work exists that attempts to discern the decision-making "styles" of powerful individual and institutional actors in the world arena,⁶⁸ little has been directed to answering the critical question, "How will a given individual or institution likely behave when it comes time to end hostilities?"

For decisionmakers close at hand, it may be useful to question them directly to discern the operating images and assumptions shaping particular ways they perceive the world.⁶⁹ What are the key individuals' identifications,

⁶⁸While there is an extensive literature, the work over the years done by Nathan Leites to develop "operational codes" rates as the class of the field: *The Operational Code of the Politburo*, op. cit.; and idem, *On the Games of Politics in France* (Stanford: Stanford University Press, 1959).

⁶⁹One of the key lessons Richard Neustadt presents in his *Alliance Politics* (New York: Columbia University Press, 1970) is the importance of different perspectives of the same situation, different expectations about likely and desirable outcomes of some shared event, and different scenarios that are operating to guide the decisionmaking processes of players who share a common tongue. Left unsaid is the additional complicating influence of language on the matter.

expectations, and demands, particularly as they relate to war termination potentialities? This exceedingly difficult research problem could be well left unexplored if war were not so terrible: fortunately, there are research and evidentiary procedures that might be used. For instance, the in-depth interview, careful biographic construction, and cross-examination all should be brought to bear with an end in view of establishing the "parameters," or operational constraints, of those involved in a war termination game. Lacking such basic information, forecasting the likely outcomes of a conflict situation will continue to be more guesswork than science.

For those to whom accessibility is restricted, research is naturally more problematic, although not impossible. Psychoanalytic profiles can be used to build up the stock of contextual materials for the termination game. The skill of the analyst is, as always, a primary ingredient required to do the job well, and the power of the technique has been admirably demonstrated by one especially capable researcher in his dissection of *The Mind of Adolph Hitler*.⁷⁰ Similar, equally skillful, and detailed investigations are needed of the key decisionmakers who would likely play in future termination games.

Negotiation is widely regarded as an "art," but as with other art forms, it yields to systematic scrutiny.⁷¹ To this end, gaming has a

⁷⁰Walter C. Langer, *The Mind of Adolph Hitler* (New York: Basic Books, 1972). Termination possibilities were daringly spelled out in broad terms in this remarkable work; see pp. 209-213.

⁷¹Fred C. Iklé, *How Nations Negotiate*, *op. cit.*, proves the contention.

distinct, but unexploited role. Several questions illustrate a few possibilities:

- o What is the characteristic scope of bargains struck with those most likely to be participants in a termination situation? Is it usually narrow and concerned with very specific details or is it general and vague?
- o How much worth is attached to human life?
- o How is the future generally perceived? Are there characteristic discount rates associated with bargains struck in the past? If so, how might this affect future bargaining situations?
- o How is the concept of "sincerity" operationalized? What is required to signal the fact that one's position is preliminary and negotiable as contrasted with a final and non-negotiable one?
- o What kinds of bargaining strategies and tactics have been "successful" and "unsuccessful" and why?
- o What can be said about the "chemistry" of successful and unsuccessful bargains? For instance, if there is some latitude in the selection of individuals to do the actual negotiating, then what are the likely combinations of personalities and circumstances that will enhance, retard, or abort proposed discussions? (This of course depends upon one's hopes and expectations about eventual outcomes.)

Once again, we are confronted with difficult and complex questions. Rather than disparing, we should begin to figure out ways of overcoming some of them. As a start, too little is being done to carefully observe the proceedings at the current Strategic Arms Limitations Talks (SALT II). Better observation and analysis here could provide an up-date on the current Soviet bargaining style and decision processes to complement the knowledge assembled from past dealings. Are the processes the same, détente notwithstanding, or are there important, probably subtle, differences operating? What are the likely consequences of such changes? And so forth. Another source of information is private businessmen who increasingly, from multi-national bases of power, bargain with bureaucrats quite like those who would conduct aspects of termination.

To assume that a Chinese general views the world in the same ways that a Russian or American general does could be quite unfortunate in some future negotiations, for example in trying to minimize the consequences of overt hostilities. Some work has been done to sort out the images and "styles" of potential antagonists, but given the requirement to know a great deal about a few very specific individuals who would be involved in a termination negotiation, one has the impression that more and better quality efforts should be expended to this end.

Communication, command, and control taken together is a third area worthy of concerted investigation if one's overriding objective is to determine whether and if a future war could be brought to conclusion short of total devastation.⁷² Are there natural "stopping points" that might be established ahead of the outbreak of war that would not exist if serious thought had not been expended beforehand? If one's objective is to end a war with minimum damage to all parties concerned, presuming that all efforts have failed to prevent it in the first place or that it has started accidentally, what can we say about the configuration of communication systems, weapon systems, or prearranged actions on the part of any or all parties? If, for example, the maintenance of Washington, D.C. as a command center is judged to be critical to the retention of a termination-before-total-destruction-is-realized capability, how might this information be made known to one's likely opponents in a nuclear war?⁷³ That is to say, if

⁷²The military has extensive experience with what is known as C³ analysis; however, the prevalent question investigated is whether a command, control, and communication system can function and/or function under attack or with varying degradations. The question posed here is fundamentally different; furthermore, it has not been as well considered.

⁷³The "decapitation" problem known to strategic analysts.

American command and control of a strategic war transfers by default to the military leadership resident inside a distant mountain in the Rockies, what happens to the likelihood that war can be terminated short of total devastation? How might the configurations of current and planned weapons systems be altered if one adopts a termination attitude? Instead of arguing over the merits of specific defensive weapons in the B-1 strategic bomber, could at least a small part of the discussion and attention be turned to the need to equip one of these aircraft as a weapon of negotiation instead of a weapon of destruction?⁷⁴ There may exist an option to end a future war short of devastation that depends upon equipping at least one aircraft with appropriate communications equipment and upon the existence of some prearranged location where end-of-war discussions could take place. This option would not logically occur unless the termination perspective were explicitly adopted. One final example helps to make the basic point. The disarmament of specific submarines or missiles may be a critical element in any terminal negotiations. How might procedures for voluntary disarmament be agreed upon in advance to avoid the less desirable contingency of having to say, "If you do not disarm, we will do it for you?"

There are extraordinary difficulties involved in terminating a war, and many of these--although far from all--⁷⁵ are based on communication

⁷⁴This idea was generated by Thomas Schelling in conversation.

⁷⁵Termination may be adjudged "treasonous" by those who are determined to press on to secure retribution for losses already incurred. The dissension and fragmentation of command inherent in this possibility may make international communication extremely treacherous for those involved. Paul Kecskemeti, *Strategic Surrender: The Politics of Victory and Defeat* (Stanford: Stanford University Press, 1958), has dealt with this matter somewhat, although considerably more reflection is called for.

with, command over, and control of the war-making machinery. Imperative is contingent planning based on a microscopic scrutiny of the likely operations of the three deadly "Cs." The use of variable levels of analysis, distinct observational perspectives, and detailed scenarios--all strengths of gaming or game-like endeavors--is obvious, even though it has not yet been undertaken with a fraction of the resources that we expend to study war initiation and implementation.